

DRAFT

Programmatic Environmental Assessment

for

Fisheries Research Conducted and Funded by the

Northwest Fisheries Science Center

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Appendix A

NWFSC Research Gear and Vessel Descriptions



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1. Trawl nets

A trawl net is a funnel-shaped net towed behind a boat to capture fish. The codend, or ‘bag,’ is the fine-meshed portion of the net most distant from the towing vessel where fish and other organisms larger than the mesh size are retained. In contrast to commercial fishery operations, which generally use larger mesh to capture marketable fish, research trawls often use smaller mesh to enable estimates of the size and age distributions of fish in a particular area. The body of a trawl net is generally constructed of relatively coarse mesh that functions to gather schooling fish so they can be collected in the codend. The opening of the net, called the ‘mouth,’ is extended horizontally by large panels of wide mesh called ‘wings’ (Figures A-1 and A-2). For many trawl nets, the mouth of the net is held open by hydrodynamic force exerted on the trawl doors attached to the wings of the net. As the net is towed through the water, the force of the water spreads the trawl doors horizontally apart. Typically, the mouth of a trawl net is held open vertically using floatation on the upper edge, or “headrope”, and weights on the lower edge, or “footrope”. For other types of trawls, the horizontal spread of the net is maintained by a beam (beam trawl; Figure A-3) or the distance between two towing vessels (pair trawl; Figure A-4).

The trawl net is usually deployed over the stern of the vessel, and attached with two cables, or ‘warps,’ to winches on the deck of the vessel. The cables are played out until the net reaches the fishing depth. The duration of the tow depends on the purpose of the trawl, the catch rate, and the target species. Commercial trawl vessels may travel at speeds between two and five knots while towing the net for up to several hours, whereas the majority of NWFSC trawl surveys involve tow speeds from 1.5 to 3.5 knots and tow durations from 10 to 30 minutes. For research purposes, the speed and duration of the tow and the characteristics of the net must be standardized to allow meaningful comparisons of data collected at different times and locations. Active acoustic devices incorporated into the research vessel and the trawl gear monitor the position and status of the net, speed of the tow, and other variables important to the research design. At the end of the tow, the net is retrieved and the contents of the codend are emptied onto the deck or sorting table.

Some NWFSC research surveys use “pelagic” trawls, which are designed to operate either near the surface or at various depths within the water column, and other surveys use “bottom” trawls (see Table 2.2-1 in the DPEA for survey protocol and net details). Examples of NWFSC trawl gear fished at the surface include the Nordic 264, Kodiak surface trawl, and paired surface trawls. Examples of NWFSC trawl gear fished lower in the water column include the Modified Cobb mid-water trawl and the Aleutian wing mid-water trawl. Pelagic trawl nets are not designed to contact the seafloor and do not have bobbins or roller gear on the footrope. Bottom trawl nets have footropes with rollers or other groundgear designed for particular sea floor conditions to maximize the capture of target species living close to the bottom and minimize damage to the gear while moving across uneven surfaces (Figure A-1). Examples of NWFSC bottom trawl nets include the modified Aberdeen trawl, Poly Nor’easter trawl, paired shrimp trawl, and beam trawls

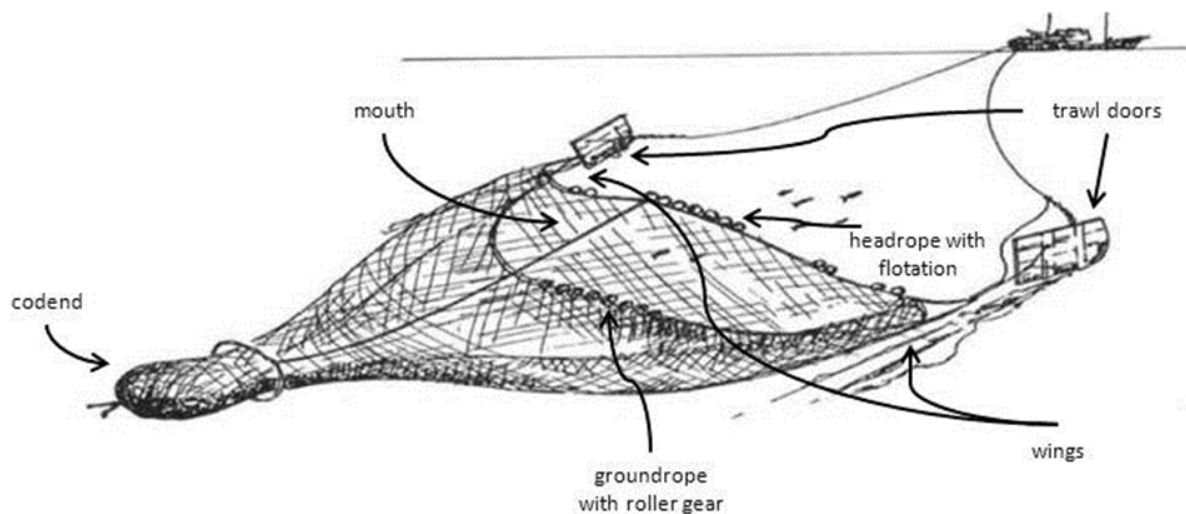


Figure A-1. Bottom trawl illustration

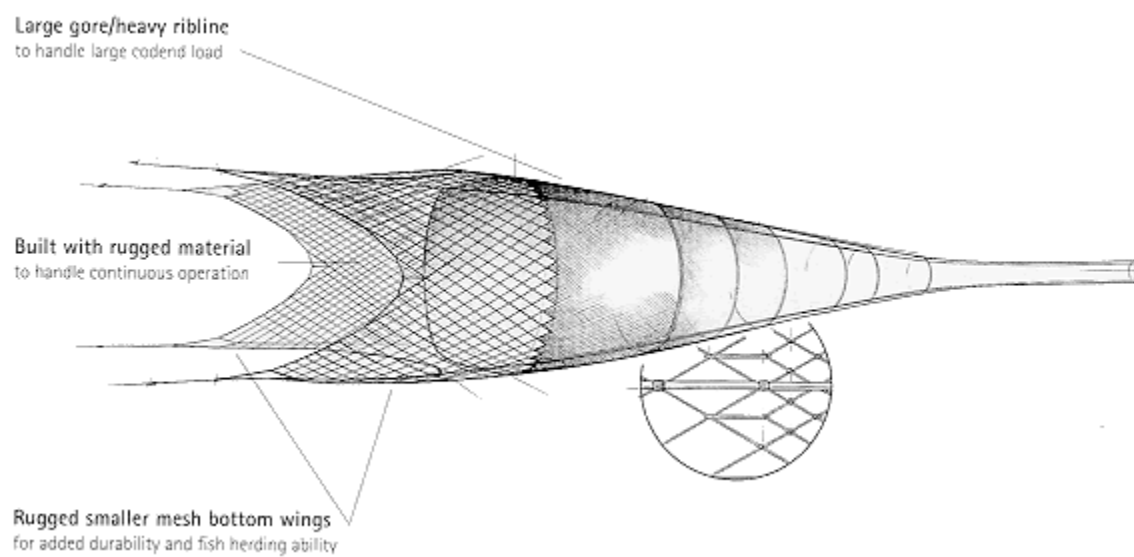


Figure A-2. Aleutian wing trawl illustration



Figure A-3. Beam trawl illustration

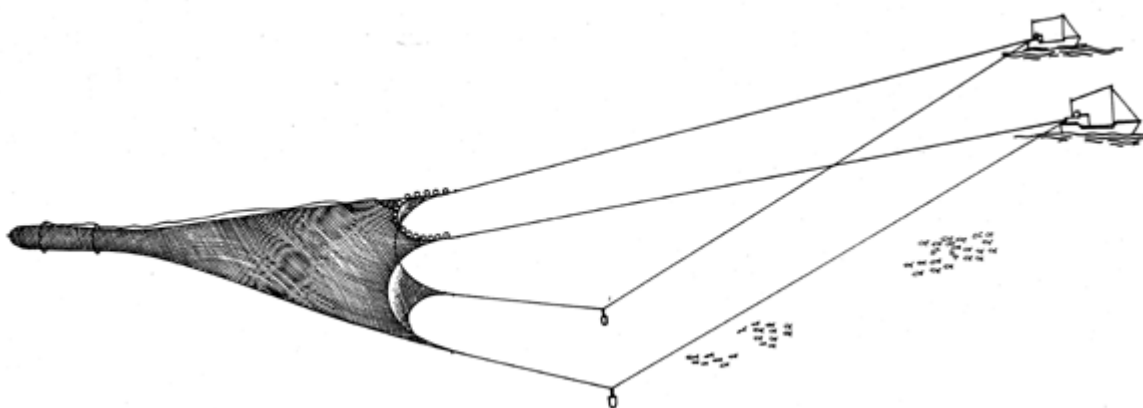


Figure A-4. Pair trawl illustration

Most NWFSC research trawlers employ a single trawl net to catch fish. The Bycatch Reduction Research Survey uses a double rigged trawl. In this method, the vessel tows two small trawl nets simultaneously rather than a single large one.

Marine mammals can become entangled by trawl gear with risks differing widely among species. Many species of marine mammals forage and swim at mid-water depths and all species come to the surface to breathe and rest, putting them at risk of being captured or entangled in pelagic trawls. Species that forage on or near the seafloor are at risk of being captured or entangled in bottom trawl netting or tow lines. There is also potential for marine mammals to interact with bottom trawl equipment near the surface of the water, as the gear is retrieved from fishing depth and brought aboard the vessel.

Recently, considerable effort has been made to develop excluder devices that allow marine mammals to escape from the net while allowing retention of the target species (e.g. Dotson et al. 2010). Marine mammal excluder devices (MMEDs) generally consist of a large rigid grate positioned in the intermediate portion of the net forward of the codend and above or below an “escape panel” constructed into the net panel (Figure A-5). The angled grate is intended to guide marine mammals through the escape panel and prevent them from being caught in the codend (Dotson et al. 2010). Different configurations of MMEDs are currently being tested on Nordic 264 nets used in the PNW Juvenile Salmon Survey.

Several NWFSC surveys use trawls with an open codend. These surveys have a reduced impact to marine organisms because they use equipment to detect or record target species and eliminate the need to capture organisms. The Pair Trawl Columbia River Juvenile Salmon Survey uses a surface pair trawl with an open codend equipped with a passive integrated transponder (PIT) detector array (discussed in detail in Section 12) to assess the passage of tagged juvenile salmon migrating from the Columbia River basin to the ocean. Another survey uses a 2-meter beam trawl with a digital video camera system (discussed further in Section 13). The trawl has an open codend and the video camera documents what goes into the net since there is no catch. A different survey also uses a 2-meter beam trawl with a video camera. In this survey, the beam trawl primarily has an open codend but a few tows are conducted with a closed codend to verify species composition identified in the video.



(Dotson et al. 2010)

Figure A-5 Marine Mammal Excluder Device installed in Nordic 264 pelagic trawl net.

2. Plankton nets

NWFSC research activities include the use of several plankton sampling nets which employ very fine mesh to sample plankton from various parts of the water column. NWFSC plankton nets employ mesh sizes from 20 to 500 micrometers. Plankton sampling nets usually consist of fine mesh attached to a rigid frame. The frame spreads the mouth of the net to cover a known surface area. Many plankton nets have a removable collection container at the codend where the sample is concentrated. When the net is retrieved, the collecting bucket can be detached and easily transported to a laboratory. Plankton nets may be towed through the water horizontally, vertically, or at an oblique angle. Often, plankton nets are equipped with instruments such as flow meters or pitch sensors to provide researchers with additional information about the tow or to ensure plankton nets are deployed consistently.

To capture plankton with vertical tows, the NWFSC uses ring nets. A ring net consists of a circular frame and a cone-shaped net with a collection jar at the codend. The net, attached to a labeled dropline, is lowered into the water while maintaining the net's vertical position. When the desired depth is reached, the net is pulled straight up through the water column to collect the sample.

A bongo net (Figure A-6) looks like two ring nets whose frames are yoked together and allows replicate samples to be collected concurrently. Bongo nets are towed through the water at an oblique angle to sample plankton over a range of depths. During each plankton tow, the bongo net is deployed to the desired depth and is then retrieved at a controlled rate so that the volume of water sampled is uniform across the range of depths. In shallow areas, sampling protocol is adjusted to prevent contact between the bongo nets and the seafloor. A collecting bucket, attached to the codend of the net, is used to contain the plankton sample. Some bongo nets can be opened and closed with remote control to enable the collection of samples from particular depth ranges. A group of depth-specific bongo net samples can be used to establish the vertical distribution of zooplankton species in the water column at a site.



Credit: Morgan Busby, Alaska Fisheries Science Center

Figure A-6. Bongo net

The Tucker net is a medium-sized single-warp trawl net used to capture plankton at different depths. The Tucker trawl usually consists of a series of nets that can be opened and closed sequentially without retrieving the net from the fishing depth.

Neuston nets are designed to capture members of the neuston, the collective term for the organisms that inhabit the water's surface. Neuston nets have a rectangular frame and are towed horizontally at the top of the water column.

3. Epibenthic tow sled

An epibenthic tow sled is an instrument that is designed to collect organisms that live on bottom sediments (Figure A-7). It consists of a fine mesh net attached to a rigid frame with runners to help it move along the substrate. The sled is towed along the bottom at the sediment-water interface, scooping up benthic organisms as it goes. NWFSC uses an epibenthic tow sled with a 1 meter by 1 meter opening and 1-millimeter mesh to collect epibenthic invertebrates in shallow eelgrass beds in Central Puget Sound.



Credit: University of South Carolina

Figure A-7. Epibenthic tow sled

4. Seine nets

A seine is a fishing net that generally hangs vertically in the water with its bottom edge held down by weights and its top edge buoyed by floats. NWFSC uses several types of seines including purse seines,

beach seines, and pole seines. A purse seine is a large wall of netting deployed around an entire area or school of fish. A purse seine has rings along the bottom of the net through which a drawstring cable is threaded. Once a school of fish is located, the vessel encircles the school with the net. The cable is then pulled in, ‘pursing’ the net closed on the bottom, preventing fish from escaping by swimming downward (Figure A-8). The catch is harvested by either hauling the net aboard or bringing it alongside the vessel. Purse seines can reach more than 6,500 feet in length and 650 feet in depth, varying in size according to vessel, mesh size, and target species (NOAA Fisheries 2014). The purse seines employed by NWFSC are between 500 and 1,500 feet in length, between 30 and 90 feet in depth, and have mesh sizes ranging from 0.45 inches to 1.3 inches depending on the location in the net.

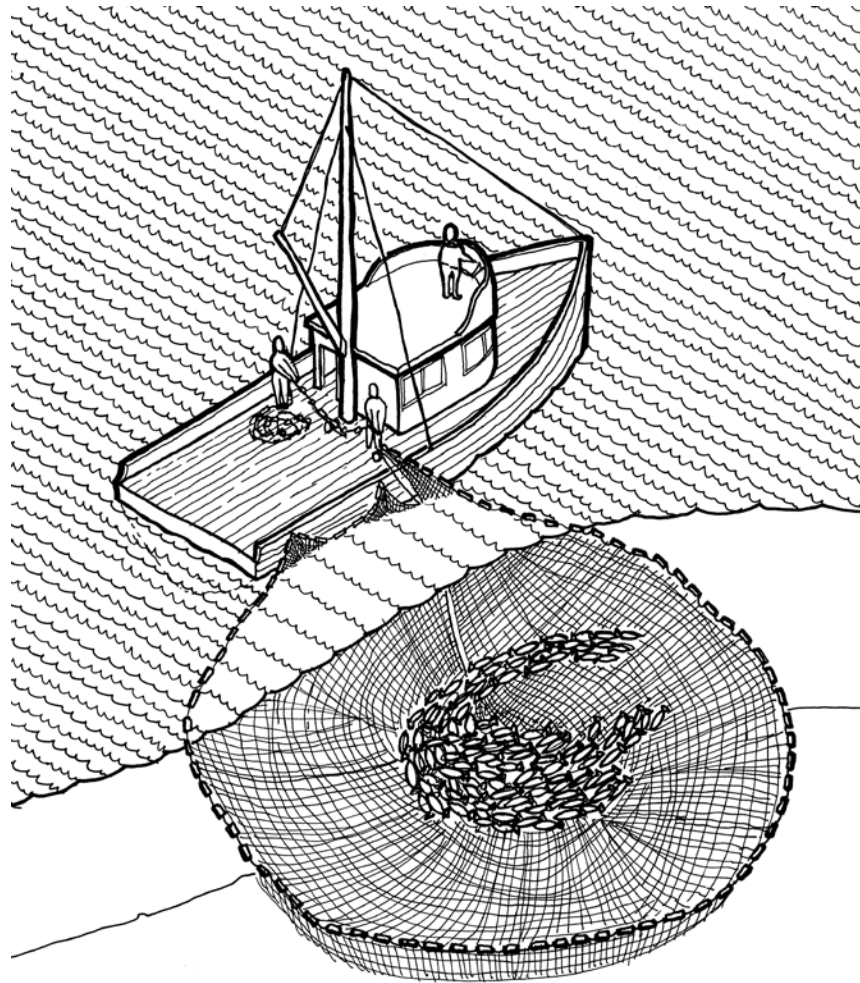


Figure A-8. Purse seine illustration

Beach seines are deployed from shore to surround all fish in a nearshore area. When setting the net, one end is fastened to the shore while the other end is set out in a wide arc and brought back to the beach. A beach seine can be deployed by hand or with the help of a small boat. When the net is set, each side is pulled in simultaneously, herding the fish toward the beach (Figure A-9). During the entire operation, the headrope with floats stays on the surface and the weighted footrope remains in contact with the bottom to

prevent fish from escaping the area enclosed by the net. The beach seines used in NWFSC research are 6 to 8 feet in depth and 120 to 150 feet in length, with mesh sizes of less than 1 inch.



Credit: Paul Olsen, NOAA Fisheries

Figure A-9. A beach seine being pulled in

A pole seine is a rectangular net that has a pole on either end to keep the net rigid and act as a handle for pulling the net in (Figure A-10). The net is pulled along the bottom by hand as two or more people hold the poles and walk through the water. Fish and other organisms are captured by walking the net towards shore or tilting the poles backwards and lifting the net out of the water. The pole seine used by NWFSC is 40 feet long, 6 feet tall, and has mesh smaller than 1 inch.

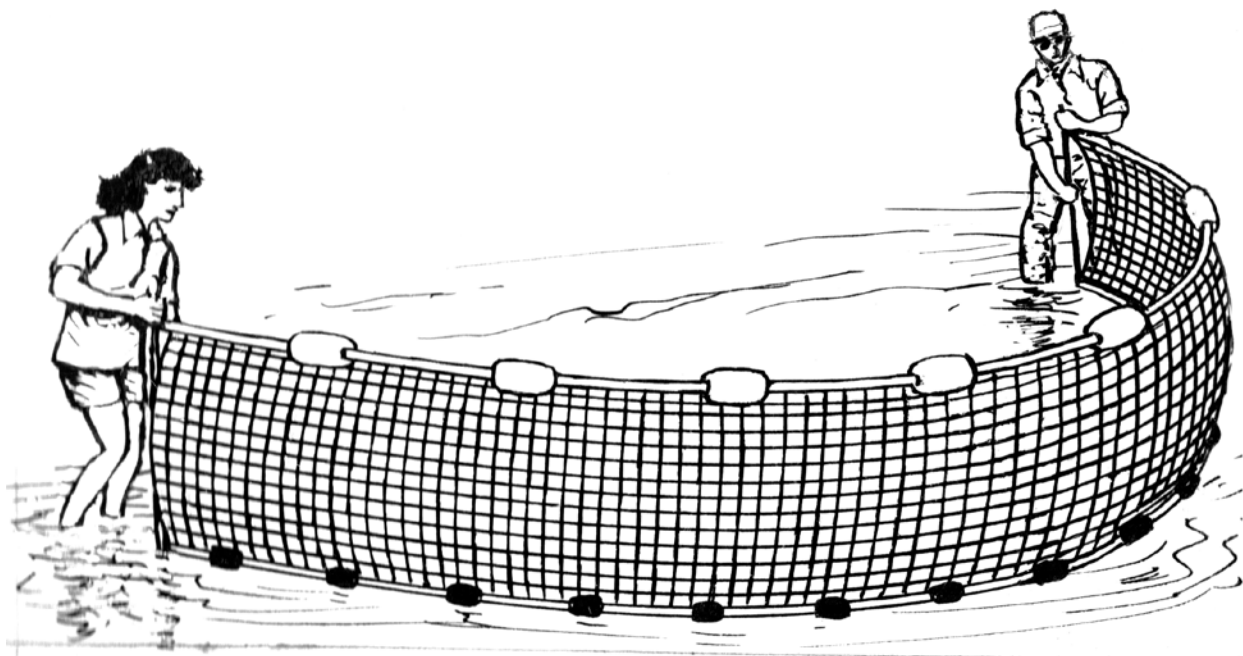


Figure A-10. Pole seine

5. Tangle net

Tangle nets are vertical panels of nylon netting and are normally set in a straight line (Figure A-11). The top of the net is buoyed with floats and the bottom of the net is weighted to maintain the net's vertical position. Tangle nets are designed for non-lethal capture of fish. The smaller mesh of a tangle net prevents fish from entering the net beyond the operculum (gill cover); instead, fish are caught by the nose or jaw. This allows fish to continue respiring and reduces their risk of injury. NWFSC uses a 600- by 40-foot tangle net with 4.25-inch mesh to catch adult salmon in the Columbia River Estuary.

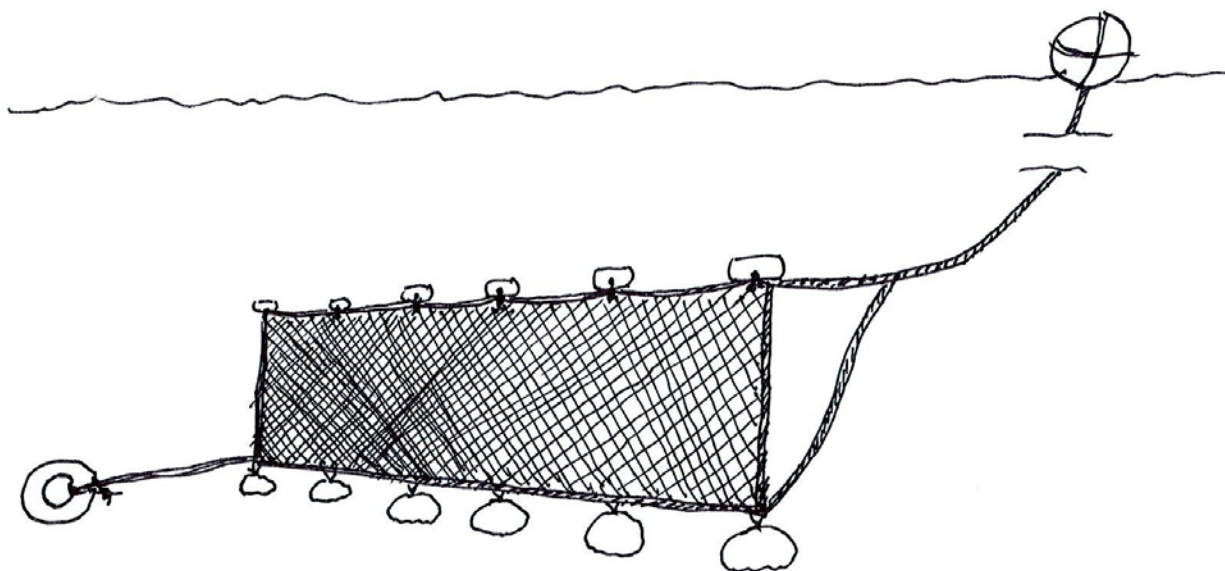


Figure A-11. Diagram of a tangle net, shown upright

6. Fish traps and pots

Fishing pots and traps are three-dimensional structures that permit fish and other organisms to enter the enclosure but make it difficult for them to escape. Traps and pots allow commercial fishers and researchers to capture live fish and can allow them to return bycatch to the water unharmed. Traps and pots also allow some control over species and sizes of fish that are caught. The trap entrance can be regulated to control the maximum size of fish that enter. The size of the mesh in the body of the trap can regulate the minimum size that is retained. In general, the fish species caught depend on the type and characteristics of the pot or trap used. Fishing traps and pots used by NWFSC include fyke traps and sablefish pots. A fyke trap consists of a trap or bag that can be conical, cylindrical, rectangular, or a floating box that are held open by frames or hoops (Figure A-12). Fyke traps are often outfitted with wings and/or leaders to guide fish towards the entrance of the actual trap. NWFSC sets fyke traps with 0.25-inch mesh for up to 6 hours in the Snohomish and Columbia river estuaries. Fyke nets are used in estuarine wetland types of habitats. The NWFSC traps channels that range in width from less than 3 ft to 15 ft. Fyke trap wings can be set up to form a barrier across a channel, trapping fish that attempt to proceed through the channel. As the tide ebbs, fish eventually seek to leave the wetland channel and are then trapped. A fyke trap is fixed on the bottom with anchors or stakes or sand bags. Usually the wings and mouth of the trap float or stick out of the water so fish cannot evade capture by swimming over the trap.

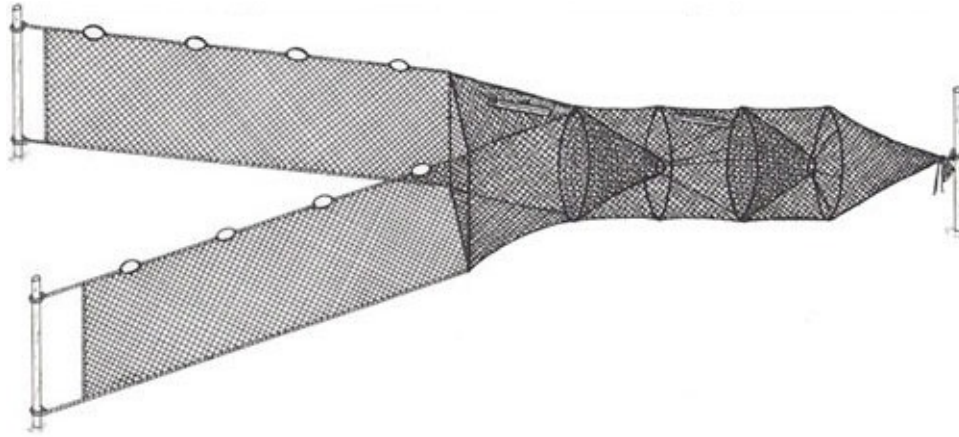


Figure A-12. Fyke trap

The NWFSC employs a limited number of conical sablefish pots (Figure A-13) to catch fish for broodstock. These pots consist of a conical-frustum-shaped frame covered in nylon netting with one or more funnel-shaped entrance tunnels. The sablefish pots used by NWFSC are 4 feet in diameter, have a soak time of 8 hours, and they are baited with squid and herring to lure fish into the pots. Sablefish pots rest on the seafloor and are often attached by a rope to a buoy at the water's surface. If a series of pots is set, a groundline may be used to connect the pots to each other to aid in pot deployment and retrieval. Modified sablefish pots are also used as predator exclusion cages for the Herring Egg Mortality Survey in Puget Sound.

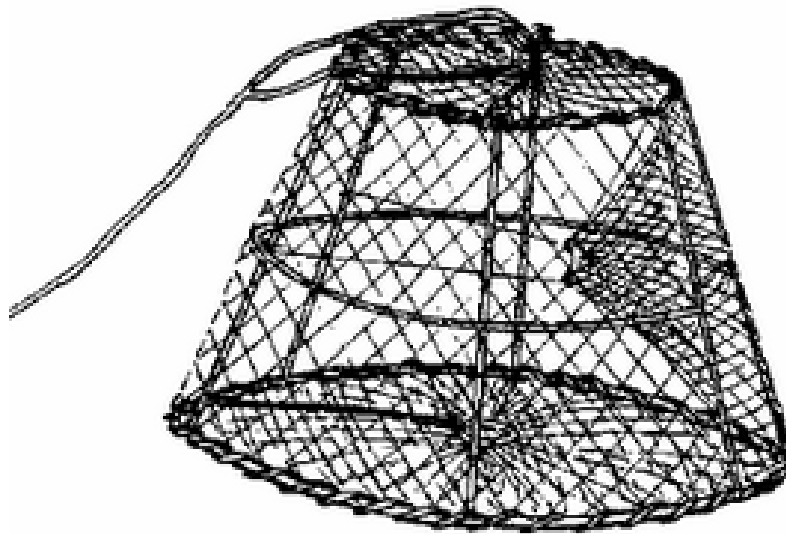


Figure A-13. Illustration of a conical sablefish pot

7. Insect traps and benthic corers

As part of the Columbia River Estuary Tidal Habitats survey, NWFSC uses insect fallout traps, emergent insect cone traps, and benthic corers to sample invertebrate prey items potentially available to juvenile salmon. Insect fallout traps measure the quantity and diversity of wetland insects falling on the surface of the water. An insect fallout trap consists of a plastic box filled approximately halfway with soapy water. The containers used by NWFSC measure 50 by 35 by 14 centimeters and have a less than 10 percent dish soap solution. The containers are surrounded by four stakes to prevent the trap from floating away while allowing it to float vertically with the tides (Roegner et al. 2004).

Emergent insect cone traps are designed to capture insects as they metamorphose from aquatic nymph to terrestrial adult. The traps used by NWFSC look like inverted plastic funnels with a collection container attached to the top to contain the emerged insects (Figure A-14). Each trap is anchored in the water and collects all insects that emerge in the 0.6-m² area directly below the mouth of the funnel.

Benthic corers are used to collect sediment and associated benthic invertebrate samples (Figure A-14). A common type of benthic corer consists of a plastic cylinder that is pressed vertically into the sediment. Then the corer has been inserted far enough into the substrate, the top of the cylinder is capped and the corer along with the sediment sample can be pulled out far enough to cap the bottom of the tube. The corer used by NWFSC collects a sample with a 0.0024-m² surface area.

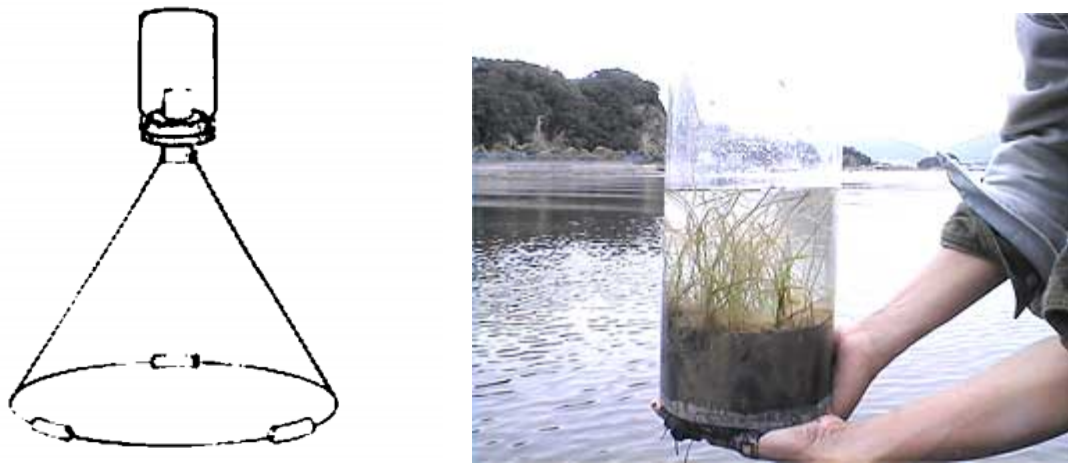


Figure A-14. An illustration of an emergent insect cone trap (left) and an example of a benthic corer with a sediment sample (right)

8. Hook-and-line Gear

Under the Status Quo, the NWFSC used rod and reel hook-and-line gear for the Southern California Groundfish Surveys that occurred within untrawlable areas. Under the Preferred Alternative, that project has been expanded to occur all along the West Coast and has been renamed, “Coastwide Groundfish Hook and Line Survey in Untrawlable Habitat”. Hook-and-line gear deployed from rod and reel was also

used for fish movement studies in Puget Sound on sixgill shark, Chinook and Coho salmon as well as lingcod. Barbed or barbless circle hooks are used depending on the needs of the research to retain or release fish with minimal injury (Figure A-15).



Figure A-15. Barbed and barbless circle hooks

Longline fishing is a type of hook-and-line gear in which baited hooks attached to a mainline or ‘groundline’ are deployed from a vessel (Figure A-16). The length of the longline and the number of hooks depend on the species targeted, the size of the vessel used, and the purpose of the fishing activity. Commercial longlines can be over 100 kilometers long and can have thousands of hooks attached, however longlines used for research purposes are much shorter. The longline gear NWFSC uses for collection of fish for broodstock consists of 500 hooks attached to a mainline approximately 750-1000 fathoms in length. Hooks are attached to the longline by thinner lines called a ‘gangions.’ The length of the gangions and the distance between each gangion depends on the purpose of the research. For NWFSC broodstock collection, the gangions are less than one foot in length and are attached to the mainline at intervals of about 10 feet.

Longline research gear can be deployed either suspended in the water column with floats (pelagic gear) or anchored to the bottom (Figure A-16) with the hooks either resting on the bottom or floating just above the seafloor (demersal gear). The NWFSC uses pelagic gear in the CCRA and demersal gear in the PSRA. Demersal longline gear has weights to hold the mainline down and buoys to provide flotation and keep the baited hooks suspended in the water. Flag buoys (or ‘high flyers’) equipped with radar reflectors, radio transmitters, and/or light sources are often attached to each end of the mainline to enable the crew to find the longline gear for retrieval.

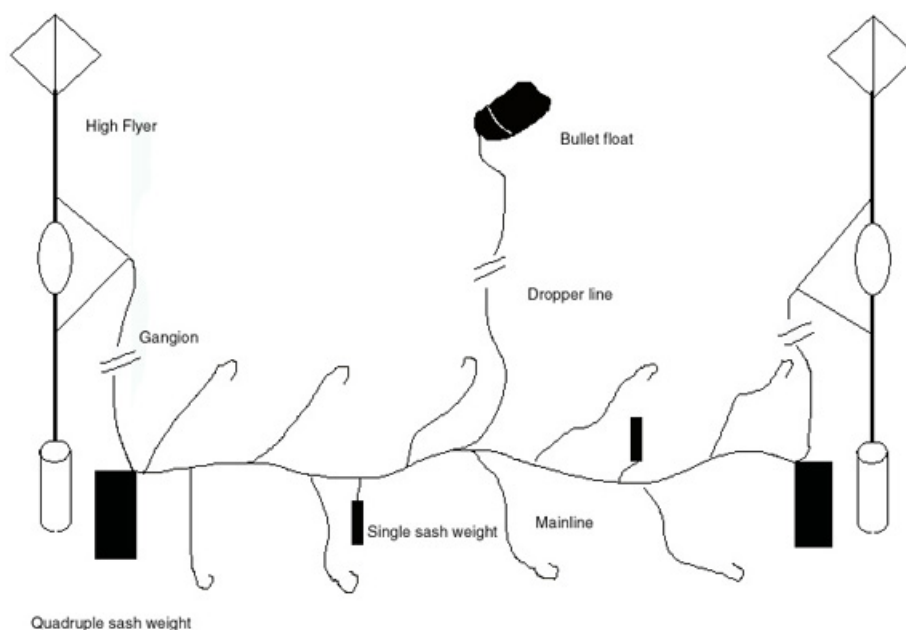


Figure A-16 Schematic example of bottom longline gear.

The time between deployment and retrieval of the longline gear is the ‘soak time.’ Soak time is an important parameter for calculating fishing effort and may be an important part of the research protocol. The optimal soak time maximizes the catch of target species while minimizing bycatch and minimizing damage to hooked target fish that may result from sharks or other predators. Soak time can also be an important factor for controlling longline interactions with protected species. Marine mammals, turtles, and other protected species may be attracted to bait, or to fish caught on the longline hooks. Protected species may become caught on longline hooks or entangled in the longline while attempting to feed on the catch before the longline is retrieved.

Birds may be attracted to the baited longline hooks, particularly while the longline gear is being deployed from the vessel. Birds may get caught on the hooks, or entangled in the gangions while trying to feed on the bait. Birds may also interact with longline gear as the gear is retrieved.

9. Electrofishing

Electrofishing is a common scientific survey method that uses electricity to momentarily stun fish or force them to involuntarily swim towards an electrical field to make them easier to capture. This method is used to sample fish populations to determine abundance, density, and species composition. NWFSC researchers use both backpack electrofishing units (Figure A-17) and boat-based electrofishing to collect fish. Both types of electrofishing use a power source to create electrical currents that flow from the positive electrode (anode) through the water to the negative electrode (cathode). When stunned fish are immobilized or move toward the anode, they are quickly captured with a dip net and placed in a bucket or holding tank. The fish can then be identified, measured, and released. Electrofishing does not result in permanent harm to the fish, which recover within a few minutes.



Credit: NOAA Fisheries West Coast Region

Figure A-17. A backpack electrofishing crew.

The person on the left is operating the backpack electroshocker and holding the anode in the water. The person on the right is using a dip net to collect stunned fish.

10. Active Acoustic Sources used in NWFSC Fisheries Surveys

A wide range of active acoustic sources are used in NWFSC fisheries surveys for remotely sensing bathymetric, oceanographic, and biological features of the environment. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus and resolution on specific objects. Table A-1 shows important characteristics of these sources used on NOAA research vessels conducting NWFSC fisheries surveys, followed by descriptions of some of the primary general categories of sources, including all those for which acoustic takes of marine mammals are calculated in the LOA application.

Table A-1 Output Characteristics for Predominant NWFSC Acoustic Sources

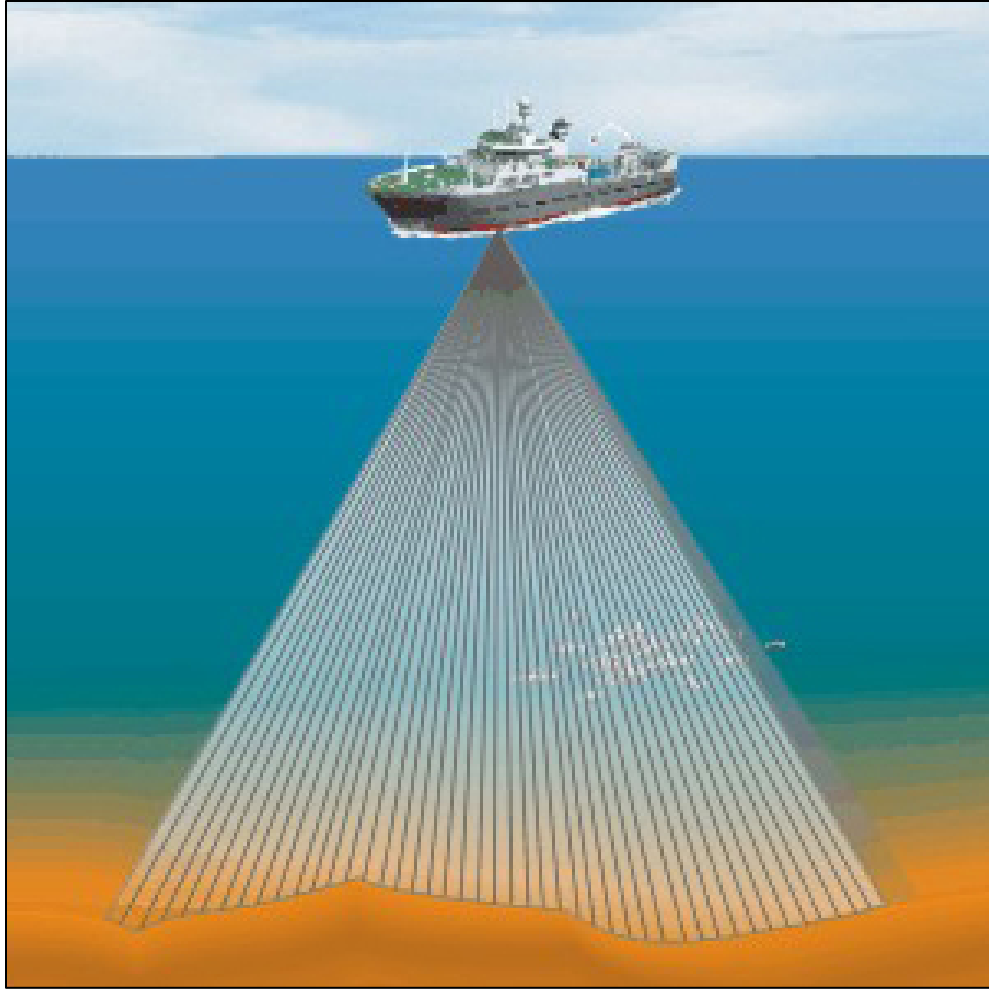
Abbreviations: kHz = kilohertz; dB re 1 μ Pa at 1 m = decibels referenced at one micro Pascal at one meter; ms = millisecond; Hz = hertz

Acoustic system	Operating frequencies (kHz)	Maximum source level (dB re 1 μ Pa at 1 m)	Single ping duration (ms) and repetition rate (Hz)	Orientation/ Directionality	Nominal beam width (degrees)
Simrad EK60 narrow beam echosounder	18, 38, 70, 120, 200 kHz	224	1 ms @ 1 Hz	Downward looking	11°
Simrad ME70 multibeam echosounder	70-120 kHz	205	2 ms @ 1 Hz	Downward looking	140°
RDI ADCP Ocean Surveyor	75 kHz	223.6	External trigger	Downward looking (30° tilt)	40° x 100°
Simrad ITI trawl monitoring system	27-33 kHz	<200	0.05-0.5 Hz	Downward looking	40° x 100°
Simrad FS70 trawl sonar	330 kHz	216	1 ms @ 120 kHz	Third wire trawl sonar for monitoring net opening and fishing conditions	5° x 20°
Simrad SX90 omni-directional multibeam sonar	70-120 kHz	206	2 ms @ 1 Hz	Downward omni-directional	0°-90° tilt angle from vertical (average)

Multibeam echosounder and sonar

Multibeam echosounders (Figure A-18) and sonars work by transmitting acoustic pulses into the water then measuring the time required for the pulses to reflect and return to the receiver and the angle of the reflected signal. The depth and position of the reflecting surface can be determined from this information, provided that the speed of sound in water can be accurately calculated for the entire signal path.

The use of multiple acoustic ‘beams’ allows coverage of a greater area compared to single beam sonar. The sensor arrays for multibeam echosounders and sonars are usually mounted on the keel of the vessel and have the ability to look horizontally in the water column as well as straight down. Multibeam echosounders and sonars are used for mapping seafloor bathymetry, estimating fish biomass, characterizing fish schools, and studying fish behavior. This gear generally emits frequencies from 38 to 200 kHz at less than 228 dB/1 μ Pa.



Credit: Simrad

Figure A-18. Conceptual image of a multibeam echosounder

Multi-frequency single-beam active acoustics

Similar to multibeam echosounders, multi-frequency split-beam sensors are deployed from NOAA survey vessels to acoustically map the distributions and estimate the abundances and biomasses of many types of fish; characterize their biotic and abiotic environments; investigate ecological linkages; and gather information about their schooling behavior, migration patterns, and avoidance reactions to the survey vessel. The use of multiple frequencies allows coverage of a broad range of marine acoustic survey activity, ranging from studies of small plankton to large fish schools in a variety of environments from shallow coastal waters to deep ocean basins. Simultaneous use of several discrete echosounder frequencies facilitates accurate estimates of the size of individual fish, and can be used for species identification based on differences in frequency-dependent acoustic backscattering between species. The NWFSC uses devices that transmit and receive at four frequencies ranging from 30 to 200 kHz.

ADCP

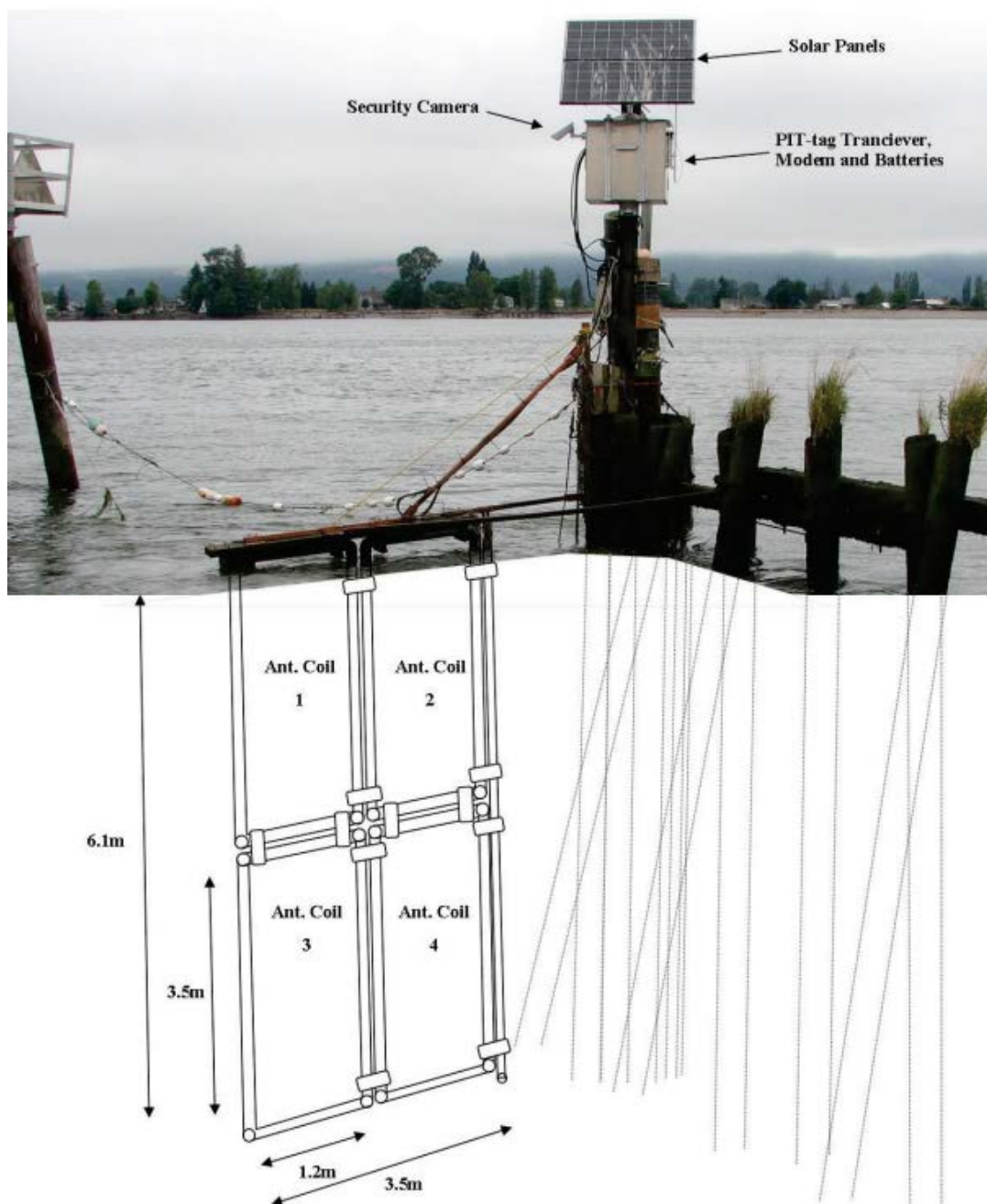
An Acoustic Doppler Current Profiler (ADCP) is a type of sonar used for measuring water current velocities simultaneously at a range of depths. An ADCP instrument can be mounted to a mooring or to the bottom of a boat. The ADCP works by transmitting "pings" of sound at a constant frequency into the water. As the sound waves travel, they ricochet off particles suspended in the moving water, and reflect back to the instrument (WHOI 2011). Sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return and particles moving toward the instrument send back higher frequency waves. The difference in frequency between the waves the profiler sends out and the waves it receives is called the Doppler shift. The instrument uses this shift to calculate how fast the particle and the water around it are moving. Sound waves that hit particles far from the profiler take longer to come back than waves that strike close by. By measuring the time it takes for the waves to return to the sensor, and the Doppler shift, the profiler can measure current speed at many different depths with each series of pings (WHOI 2011).

11. Acoustic telemetry

Acoustic telemetry for fisheries research employs acoustic tags which are small, sound-emitting devices allowing the detection of fish or aquatic invertebrates. An acoustic tag, or transmitter, is an electronic device usually implanted or externally attached to an aquatic organism. A tag transmits short ultrasonic signals (typically 69 kHz) either at regular intervals or as a series of several pings that contain a digital identifier code (which allows researchers to identify individual fish) and sometimes physical data (e.g., temperature). An acoustic receiver detects and decodes transmissions from acoustic tags. NWFSC uses Vemco VR2 receivers moored in fixed locations to detect the presence or absence of coded tags. For the Effects of Dredging on Crab Recruitment survey, NWFSC uses V9-2H transmitters to track Dungeness crab movements. These tags have a battery life of 100 to 280 days.

12. PIT tags and antennas

The passive integrated transponder (PIT) is a type of radio frequency identification used extensively in fisheries research. A PIT tag consists of an integrated circuit chip, capacitor, and antenna coil encased in glass. PIT tags vary in size and shape depending on the study animal. Generally, tags are cylindrical in shape, about 8-32 mm long, and 1-4 mm in diameter. PIT tags can be inserted in fish or other organisms via large-gauge hypodermic needles. Unlike acoustic tags (described in Section 13), PIT tags are dormant until activated and do not require an internal source of power. To activate the tag, a low-frequency radio signal is emitted by a scanning device that generates a close-range electromagnetic field. The tag then sends a unique alpha-numeric code back to the reader, allowing researchers to identify specific individuals (Smyth and Nebel 2013). NWFSC uses stationary PIT detection antennas in the Columbia River Estuary to detect migrating adult and juvenile salmon (Figure A-19). NWFSC also uses a PIT detector array attached to a surface pair trawl with an open codend (described in Section 1) which is towed at a depth of 5 meters for 8 to 15 hours at a speed of 1.5 knots in the Columbia River Estuary to assess the passage of migrating juvenile salmon.



Credit: NWFSC

Figure A-19. Configuration of antennas for a PIT tag detector on a pile dyke in the Columbia River Estuary

13. Video cameras

The NWFSC uses several apparatuses to collect underwater videos of benthic habitats and organisms. These include a CamPod, a video camera sled, video beam trawls, and a remotely operated vehicle

(ROV). Each apparatus includes a video camera system consisting of a digital video camera, lights, and a power source. The CamPod (Figure A-20) is a lightweight, three-legged platform equipped with a video system and adequate illumination. The frame holds a 35-millimeter stills camera system and two video cameras – one that provides a forward-looking oblique view and a high-resolution video camera that faces downward. Designed primarily for making images of the benthic environment, the configuration of the device focuses on minimizing its hydrodynamic presence in the field of view of the cameras. The CamPod is deployed vertically through the water column on a cable and is intended to view one point on the bottom.



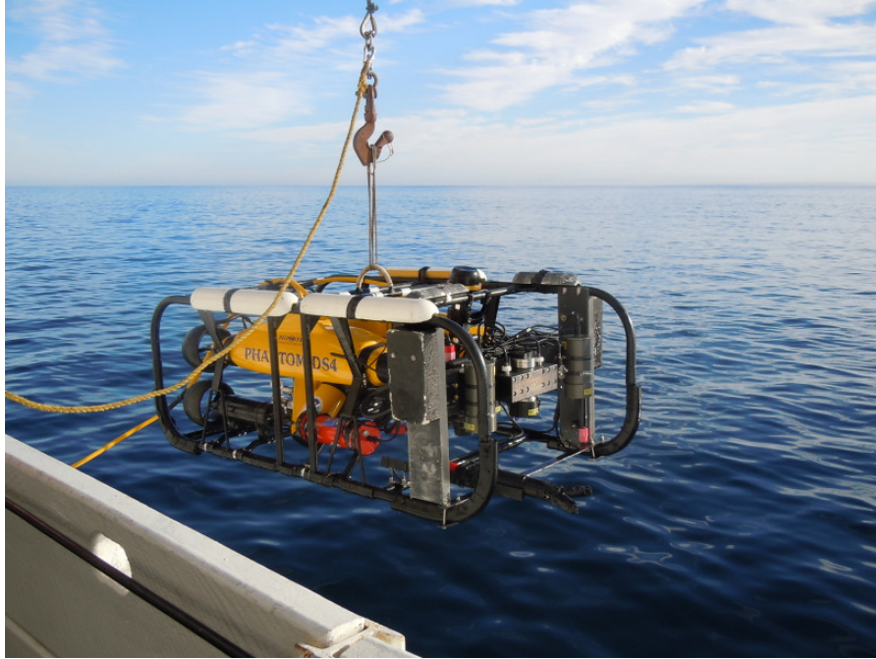
Credit: Northwest Atlantic Fisheries Organization

Figure A-20. A CamPod being deployed from a vessel

A video camera sled consists of a video camera system mounted on a metal frame with runners to allow it to move along the benthic substrate. A research vessel tows the sled along the seafloor, allowing the camera to capture video footage of the benthic environment.

The video beam trawls used by NWFSC are similar to video camera sleds. Video beam trawls consist of a video camera system attached to a beam trawl (described in Section 1) which is towed along the seafloor at speeds of 1 to 1.5 knots. NWFSC uses video beam trawls to assess the seasonal and interannual distribution of young of the year groundfishes as well as the potential effects of hypoxia on groundfish.

NWFSC uses a video ROV (Figure A-21) to capture underwater footage of the benthic environment. The ROV is controlled and powered from a surface vessel. Electrical power is supplied through an umbilical or tether which also has fiber optics which carry video and data signals between the operator and the ROV. This enables researchers on the vessel to control the ROV's position in the water with joysticks while they view the video feed on a monitor.



Credit: Southwest Fisheries Science Center

Figure A-21. A remotely operated vehicle (ROV) being deployed from a vessel

14. CTD profiler and rosette water sampler

‘CTD’ stands for conductivity, temperature, and depth. A CTD profiler measures these and other parameters, and is the primary research tool for determining chemical and physical properties of seawater. A shipboard CTD is made up of a set of small probes attached to a large (1 to 2 meters in diameter) metal rosette wheel (Figure A-22). The rosette is lowered through the water column on a cable, and CTD data are observed in real time via a conducting cable connecting the CTD to a computer on the vessel. The rosette also holds a series of sampling bottles that can be triggered to close at different depths in order to collect a suite of water samples that can be used to determine additional properties of the water over the depth of the CTD cast. The duration of a CTD cast varies depending on water depth. The data collected at different depths are often called a depth profile, and are plotted with the value of the variable of interest on the x-axis and the water depth on the y-axis. Depth profiles for different variables can be compared in order to glean information about physical, chemical, and biological processes occurring in the water column.

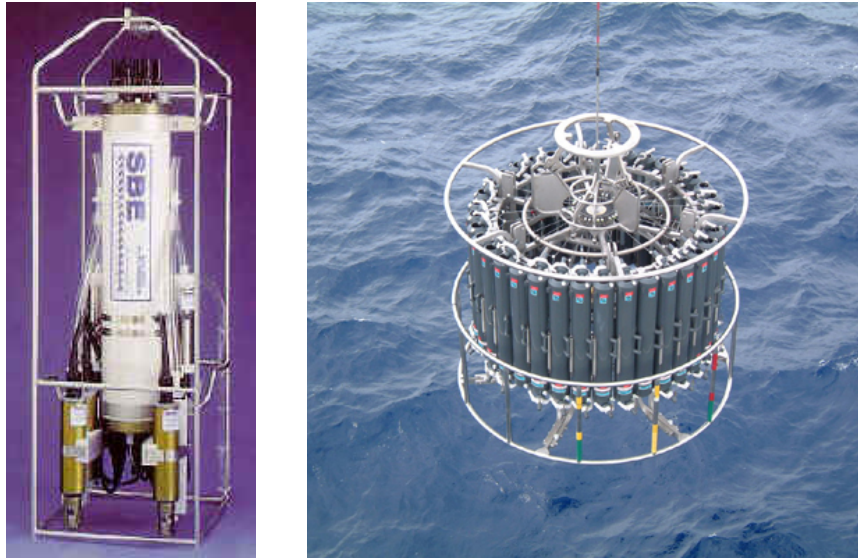


Figure A-22. Sea-Bird 911 plus CTD profiler (left) and CTD profiler deployment on a sampling rosette (right)

Conductivity is measured as a proxy for salinity, or the concentration of salts dissolved in seawater. Salinity is expressed in ‘practical salinity units’ which represent the sum of the concentrations of several different ions. Salinity is calculated from measurements of conductivity. Salinity influences the types of organisms that live in a body of water, as well as physical properties of the water. For instance, salinity influences the density and freezing point of seawater.

Temperature is generally measured using a high-sensitivity thermistor protected inside a thin walled stainless steel tube. The resistance across the thermistor is measured as the CTD profiler is lowered through the water column to give a continuous profile of the water temperature at all water depths.

The depth of the CTD sensor array is continuously monitored using a very sensitive electronic pressure sensor. Salinity, temperature, and depth data measured by the CTD instrument are essential for characterization of seawater properties. CTD profilers can be outfitted with instruments such as fluorometers, transmissometers, and dissolved oxygen sensors to measure additional water quality parameters. A fluorometer measures fluorescence and can be used to detect chlorophyll-a concentrations, an indicator of phytoplankton biomass. A transmissometer measures the transmission of light through water, which is essential to the productivity of oceans. Transmittance is reduced when light is scattered and absorbed by suspended particles, phytoplankton, bacteria, and dissolved organic matter. Dissolved oxygen sensors measure the amount of oxygen gas that is dissolved in seawater. Dissolved oxygen affects ocean chemistry and is essential for many marine organisms such as fish and invertebrates. Dissolved oxygen concentrations are impacted by environmental conditions such as temperature, salinity, turbidity, and plankton blooms.

15. Thermosalinograph and water pump, water level and temperature loggers

The CTD is not the only tool NWFSC uses to collect water quality parameters. Onboard the research vessel for the Juvenile Salmon Pacific Northwest Coastal Survey, NWFSC uses a continuous water pump with an SBE-45 MicroTSG thermosalinograph to measure sea surface conductivity and temperature. The pump continuously pumps seawater from a depth of 3 meters near the bow of the research vessel to the thermosalinograph which sends the temperature and conductivity data to a shipboard computer. The importance of conductivity and temperature measurements is described in Section 14.

To collect physical environmental data in riverine and estuarine habitats, NWFSC uses water level and temperature loggers. These devices are placed underwater at fixed locations where they continuously record data. NWFSC uses a 3 by 4 centimeter device called a TidbiT to measure and record water temperatures. To log water levels, NWFSC uses a Hobo U-model water level data logger. These devices record measurements at user defined intervals and generally have the memory and battery power to record thousands of measurements over several years.

16. NWFSC Vessels used for Survey Activities

NMFS employs NOAA-operated research vessels, chartered vessels, and vessels operated by cooperating agencies and institutions to conduct research, depending on the survey and type of research.



Figure A-23. R/V *Bell M. Shimada*

New to NOAA in 2010, the R/V *Bell M. Shimada* (Figure A-23) is one of the most technologically advanced fisheries vessels in the world. Many of the advances are focused on making the boat quieter and reducing disturbance to marine life. The vessel is fourth in the series of new fisheries survey vessels built for NOAA by VT Halter Marine, Inc. R/V *Bell M. Shimada* is home ported in Newport, OR and is shared by the SWFSC and the NWFSC. The vessel is 209 feet in length with a diesel electric drive system with two 1,508-horsepower propulsion motors and one 14.1-foot propeller. The deck has an oceanographic winch, two stern trawl winches, and two A-Frame winches. The ship can cruise at 12 knots. The R/V *Bell M. Shimada* can accommodate 39 crewmembers, including 15 scientists. The technologies on the boat offer scientists the ability to monitor fish populations without altering their behavior, allowing accurate data collection.



Figure A-24. R/V Pelican

The R/V *Pelican* (Figure A-24) is a 39-foot aluminum pontoon boat owned by NWFSC and is specifically designed for purse seining. It has a pilothouse, a flat back deck, and mast and boom for purse seining. There are no rails on the starboard side to facilitate deployment of the purse seine. The vessel is propelled by an inboard gas engine and has a separate gas engine, surface mounted on the aft port side, to run the water system as well as the hydraulics for the purse seine winch. R/V *Pelican* and accompanying skiff, R/V *Tule*, are used exclusively for studying salmon habitat-use in the Lower Columbia River estuary.



Credit: NOAA

Figure A-25. **R/V *Noctiluca***

The R/V *Noctiluca* is a 26-foot NMFS vessel with a center console (Figure A-25). This aluminum skiff, made by Pacific Boats, has a draft of 2 feet and a beam of 8.5 feet. The vessel is propelled by a 225-horsepower Honda outboard engine and has a 9.9-horsepower Honda kicker motor.



Credit: NWFSC

Figure A-26. **R/V *Minnow***

The R/V *Minnow* is a 21-foot NMFS vessel made by Workskiff (Figure A-26). The vessel has a 2.5-foot draft, an 8-foot beam, an aluminum hull, and a T-top center console. It is propelled by a 135-horsepower Honda outboard engine and has an 8-horsepower Honda kicker motor.



Figure A-27. *R/V Tule*

The R/V *Tule* is a 19-foot Magnum-brand aluminum skiff with a 90-horsepower Honda outboard engine (Figure A-27). It has a center console and a hefty towing post in the back for pulling in a purse seine. The skiff accompanies the purse seiner R/V *Pelican*. Both vessels are used exclusively for studying salmon habitat-use in the Lower Columbia River estuary.



Credit: David Fox, Oregon Department of Fish & Wildlife

Figure A-28. R/V *Elakha*

The R/V *Elakha* is a 54-foot, aluminum-hulled vessel owned by Oregon State University (Figure A-28). The vessel was built by Rozema Boat Works in Mount Vernon, WA and is propelled by a Caterpillar 3176B 6-cylinder diesel engine, capable of up to 600 horsepower. The R/V *Elakha* is home ported in Newport, OR and has a draft of 5 feet and a beam of 16.5 feet. It is outfitted with an A-frame, a winch, a transducer well, and other scientific equipment.



Figure A-29. *M/V Forerunner*

The M/V *Forerunner* is a 50-foot, steel-hulled vessel owned by Clatsop Community College (CCC) in Astoria, Oregon (Figure A-29). Originally launched as a commercial fishing vessel in 1969, CCC acquired M/V *Forerunner* in 1974. The vessel underwent a major overhaul in 2010. M/V *Forerunner* has a draft of 6.5 feet and is propelled by a 335-horsepower engine (CCC 2013).

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